Position Paper - banning PFAS pesticides and other sources of TFA

PAN Europe

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I. Background: PFAS, PFAS pesticides and degradation into TFA

Poly- and perfluoroalkyl substances (PFAS), known as 'forever chemicals' due to their extreme persistence, are a synthetically produced group of substances. This group is defined by the presence of at least one fully fluorinated methylene group ($-CF_3$) or methylene carbon atom ($-CF_2$) group (without any hydrogen, chlorine, bromine, or iodine atom attached to it) in their chemical structure (OECD, 2021). Carbon-fluorine bonds, amongst the strongest in organic chemistry, were often deliberately introduced into these compounds to give PFAS an exceptionally high resistance to chemical and thermal degradation[1]. The synthetic chemistry of PFAS, engineered for their commercial success, is at the root of their pernicious effects on humans and the environment. Their composition allows PFAS to pass into soil and groundwater across long distances, and to readily enter and bioaccumulate in terrestrial and aquatic food chains (Brunn et al., 2023). The toxicity of PFAS to human health is well-established; known effects include infertility, liver damage, endocrine disruption, thyroid disease, high cholesterol levels, a weakened immune system, and several cancers (European Environmental Agency, 2019). Children and developing foetuses are the ones most susceptible to their toxic effects. As a result, the European Commission has acknowledged that PFAS pollution is one of the biggest chemical threats to human and environmental health, and has made a commitment to phase out their use under a global PFAS restriction[2].

Carbon-fluorine bonds were designed into **PFAS pesticides** to increase their molecular stability in vivo, ensuring that biological activity persists long after application, as well as to enhance effectiveness by improving potency, specificity and effective action. This design, with often just one fully fluorinated carbon, is so effective at extending the longevity of PFAS, that the fluorinated part of the molecule will continue to persist in the degradation products of PFAS pesticides, notably as trifluoroacetic acid (TFA).

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[1] As well as other industrially useful properties.
[2] Chemicals strategy for sustainability

TFA is the final degradation product of many PFAS[3] and is by far the most abundant PFAS in the environment according to the current state of knowledge (Arp et al., 2024). Scientific calculations from the German Environment Agency (UBA) have demonstrated that PFAS pesticides are the primary source of TFA contamination in agriculture, accounting for 76% of TFA groundwater contamination with TFA[4]. TFA is very mobile, water-soluble and highly persistent. This allows it to readily accumulate in water resources, including groundwater (Vierke et al., 2014), as well as to enter in the soil and be taken up by plants, where it bioaccumulates (Arp et al., 2024). Agricultural crops are therefore not only directly contaminated by TFA through the application of PFAS pesticides, but also indirectly through TFA that has leached into water resources as a degradation product of PFAS pesticides.

Given TFA's extreme persistence and its continued emissions, concentrations in the environment are rising irreversibly (Arp et al., 2024). Studies show that TFA concentrations have been increasing in groundwater (Albers & Sültenfuss, 2024), surface waters (Cahill, 2022), and plants (Freeling et al., 2022), and have been widely detected within water resources including precipitation (Freeling et al., 2020), oceans (Frank et al., 2002), and drinking water[5] as well as in plant-based food (EURL-SRM, 2017), including baby food (Hees et al., 2024), and in human blood (Duan et al., 2020). Data trends imply that this widespread TFA accumulation poses a planetary boundary threat, with the potential to disrupt vital Earth system processes (Arp et al., 2024). See also Box below.

PAN Europe's investigations on TFA

TFA in surface water and groundwater

Investigations by PAN Europe and its members have confirmed the ubiquity of TFA in water resources. A PAN Europe analysis of 23 surface water and 6 groundwater samples across ten EU Member States found TFA in all samples, at more than 98% of total PFAS detected. In 79% of the total samples, TFA concentrations exceeded 0.5 µg/l, the proposed parametric value for PFAS Total in drinking water in the recast Drinking Water Directive.

TFA in drinking water (tap, spring and mineral waters)

In a follow up analysis by PAN Europe and its members, TFA was detected in 34 out of 36 European tap water samples (94 %) from eleven EU Member States and in 12 of 19 bottled mineral and spring waters (63 %). TFA made up the dominant (> 98 %) PFAS contamination in mixtures of samples. These results clearly show that TFA contamination extends beyond surface and tap water resources to groundwater and deep aquifers that supply mineral water, which are trusted to be protected from human-made pollutants.

TFA in wine

In another survey, PAN Europe and its members revealed an exponential rise in TFA concentrations in European wines since 2010. TFA was not detected in wines from before 1988, while wines from 2021–2024 were all contaminated with an average TFA level of 122 µg/L, and some peaks over 300 µg/L. Wines from all countries showed levels of TFA several orders of magnitude higher than the already high background levels in water. Wines with higher levels of TFA also had a higher number

[3] Specifically, PFAS which contain a C atom bound to their CF3 group (C-CF3).
[4] According to Table 6 on page 51, the theoretical release of TFA attributed to pesticides is 434 tonnes. When considering the total theoretical TFA release from all sources (434 + 22 + 19 + 96 = 571 tonnes), pesticides account for approximately 76% of the total. UBA.
[5] PAN Europe, TFA: The Forever Chemical in the Water We Drink, 2024 [link].

and concentration of synthetic pesticide residues. These results align with previous findings that PFAS pesticides are the primary source of TFA contamination in agriculture.

It is important to note that conventional water treatment techniques are not suitable for removing TFA from drinking water. Currently, the only available effective treatment is reverse osmosis, a highly costly, energy-intensive and resource demanding process that generates significant wastewater. A cross-border journalistic investigation has evaluated that the cost of remediating emerging ultra-short chain PFAS like TFA in Europe would amount to over 100 billion EUR per year for water and soil (Horel & Aubert, 2025).

TFA's health impacts - a little-explored area of knowledge

Despite the risk of lifelong and widespread exposure to TFA (Arp et al., 2024), and the established toxicity of structurally similar PFAS, until recently there was a complete lack of studies on TFA's long-term toxicity and carcinogenicity, as well as on its endocrine, immunotoxic and neurotoxic effects. Only recently were studies of long-term reproductive toxicity and developmental toxicity performed, which indicated adverse effects. In particular, the study on developmental toxicity commissioned by the industry itself has shown that pre-natal exposure to TFA causes severe eye and skeleton defects in rabbit foetuses. Liver toxicity in rats has also been consistently reported and recent results point to potential reproductive effects in offspring (adverse effects on testis weight and sperm quality).

A further knowledge gap on TFA is the absence of assessment of 'cocktail effects', where exposure to multiple chemicals results in increased combined toxicity, through cumulative (additive) and/or synergistic effects.

Debunking industry myths on TFA

The chemical industry strives to weaken and delay restrictions on PFAS by downplaying their dangers through narratives that aim to distort public discourse and influence science (Gaber et al., 2023). A widespread industry narrative is that short-chain PFAS like TFA pose no danger to health, and therefore there is no need to regulate TFA at the same level as longer-chain PFASAs mentioned above, this myth of TFA's harmlessness is now being discredited by a growing body of scientific studies. A second industry myth is that TFA is naturally occurring, emitted through deep-sea hydrothermal vents (e.g. Scott et al., 2005). A critical evaluation of this claim has shown it is unsupported by evidence, and moreover inconsistent with time trends of TFA concentrations in rain and ice cores (Joudan et al., 2021).

Sales of TFA-emitting PFAS pesticides on the rise

Currently, 32 PFAS are approved as active substances in pesticides in the EU, accounting for approximately 15% of all authorised synthetic active substances (see Annex). Due to their chemical structure, almost all are precursors of TFA and will release it upon degradation (Joerss et al., 2024). Out of these, only 9 PFAS active substances are approved as candidates for substitution, i.e. identified as 'more hazardous' pesticides, the rest have been so far treated as non-hazardous. Meanwhile, rising pesticides sales suggest an increasing trend in the use of PFAS pesticides in France, Belgium, Austria, and Germany. As shown by an analysis carried out by PAN Europe, PFAS pesticide residues detected in fruit and vegetables have nearly tripled between 2011 and 2021.

II. Regulatory state of play

In recognition of the alarming scale of the chemical pollution crisis, the European Union has committed to gradually ban PFAS, and in 2020 announced its Chemicals Strategy for Sustainability as a first step towards achieving its zero-pollution ambition.

In February 2023, the European Chemicals Agency received a proposal from authorities in Denmark, Germany, the Netherlands, Norway and Sweden for a group ban on the manufacture, use and import of PFAS. However, PFAS active substances used in pesticides were exempted from the PFAS restriction proposal, on the assumption that these are sufficiently regulated by the existing Pesticide Law, Regulation 1107/2009, which governs the approval and authorisation of pesticides in the EU. Pesticide co-formulants, however, are included in the scope of the proposal for a PFAS restriction.

Regulation 1107/2009 seeks to ensure a high level of protection from the harmful effects of pesticides for EU citizens, animals and the environment. According to Article 4(3) and based on the precautionary principle of Article 1(4), pesticide active substances and products placed on the market shall have no immediate or delayed effects on human health, directly or through drinking water, or on groundwater. To protect water resources, this Regulation prohibits the approval of any active substance or pesticide product whose active substances or 'relevant' metabolite(s) (degradation products) are likely to contaminate groundwater above the legal limit of 0.1 µg/L set out in the Groundwater Directive 2006/118/EC. A metabolite is deemed toxicologically relevant if there is reason to assume it has toxicological properties that are considered 'unacceptable'.

It was in 1998 that TFA was first identified as a metabolite of a PFAS pesticide risking to contaminate groundwater. Nevertheless, the toxicity of TFA was little investigated by regulators. The substance was not considered toxicologically relevant for the following decades. Toxicological reference values of safe thresholds of exposure were first set by EFSA in 2014. These thresholds were based on a very limited toxicity dataset and concluded TFA posed no risk to consumers.

In 2024, however, evidence of TFA's reproductive toxicity from the aforementioned industry study led Germany to submit a proposal for a hazard classification of TFA as toxic for reproduction category 1B, very persistent and very mobile (vPvM), and persistent, mobile and toxic (PMT), under Regulation 1272/2008. Following this evidence, the European Commission acknowledged TFA to be a relevant metabolite in groundwater and requested EFSA to review TFA toxicological reference values. TFA manufacturers themselves have already carried out a self classification, categorising TFA as suspected of being toxic for reproduction (Category 2), with the hazard statement: "Suspected of damaging the unborn child."

As a 'toxicologically' relevant metabolite, the 0.1 µg/L groundwater limit applies to TFA. Alarmingly, TFA contamination in groundwater routinely exceeds the 0.1 µg/L limit for relevant metabolites[6] and in some cases surpasses even the 10 µg/L threshold for non-relevant metabolites in groundwater[7]. This constitutes a clear indication that the requirements of the Pesticide Regulation, namely its Article 4(3) and Article 29(1)(e), and its uniform principles set out in Regulation 546/2011 are no longer met by pesticide products containing PFAS active substances. Therefore all applications for renewals should be refused, and ongoing approvals should be withdrawn. According to Article 44 (3,a) of the EU Pesticide Regulation,

[6] Austria, Denmark
[7] Germany, Sweden, Switzerland.

Member States are also required to withdraw the authorisations of all the concerned products that contain PFAS pesticides.

During a conference organised by PAN Europe at the European Parliament, scientists, experts, and policymakers all agreed on the urgent need to take action against TFA. Water companies and a group of 50 MEPs explicitly called for a ban on PFAS pesticides. Meanwhile, the Flemish Parliament is discussing a proposal to ban the use of PFAS pesticides in Flanders.

Today, neither the World Health Organisation (WHO) nor the European Union or its Member States have set a binding limit value for TFA in drinking water. Hence, some Member States have adopted their own health guideline values for TFA in drinking water.

Table: Guidance health-based value derived for TFA

Flanders (2024)	15.6 µg/L
Germany (2020)	60 µg/L
Luxembourg (2024)	12 µg/L
The Netherlands (2023)	2200 ng/L (2.2 µg/L)

The Flemish and Dutch values, albeit based on different methodological approaches, take into account the limited toxicological data available for TFA, as well as the growing body of evidence regarding structurally related PFAS. On the contrary, the German value does not take into account the uncertainties regarding TFA toxicity[8]. Pending a harmonised European value, other Member States (regions) have chosen to rely on one of these values (France: 60 µg/L; Wallonia: 2.2 µg/L). Nevertheless, only the Netherlands (and Wallonia) has considered children’s exposure in their calculations. The European Commission tasked the WHO to derive a guidance health-based value for TFA in drinking water.

III. Policy demands

a) Put an end to pollution at the source

The Commission and Member States must take action to **immediately ban all PFAS pesticides** under the Pesticide Regulation:

- The Commission should propose the non-renewal or withdrawal of all PFAS active substances approved in the EU as soon as possible, and be endorsed by Member States
- Without waiting for regulatory action from the Commission, Member States should comply with their obligation to review and withdraw national authorisations of pesticide products containing PFAS active substances.

To ensure the phase-out of TFA from other sources, **the EU proposal for a universal restriction on PFAS** should be swiftly adopted and implemented.

[8] For details, refer to TFA: the Forever Chemical in the water we drink (English) or TFA: Générations Futures alerte sur la gestion des pouvoirs publics (French).

b) Define and adopt precautionary health-based values

EFSA and the WHO should establish precautionary toxicological reference values and health-based guidance ensuring the protection of the most vulnerable groups such as toddlers and pregnant women, as part of their respective mandate, and taking into account background TFA levels. As a result, a **parametric value for TFA** should be adopted for drinking water *via* a revision of the Drinking Water Directive.

c) Monitor exposure levels

The presence of TFA in drinking water and mineral water, as well as in plant-based products should be monitored precisely and regularly by the competent authorities.

In line with the recommendation of the Scientific Committee on Health, Environmental and Emerging Risks, an **environmental quality standard** in surface and groundwater should be adopted under the Water Framework Directive.

d) Apply the Polluter Pays Principle

Wherever necessary, TFA-producing companies should pay for the costs of measures taken to prevent, control and remedy TFA pollution.

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Pesticide Action Network (PAN Europe) is a network of NGOs working to reduce the use of hazardous pesticides and have them replaced with ecologically sound alternatives. We work to eliminate dependency on chemical pesticides and to support safe sustainable pest control methods. Our network brings together over 45 consumer, public health and environmental organisations and women's groups from across Europe.

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